

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of:

Karl Littau, et al.

Application No.: 08/893,917

Filed: July 11, 1997

For: REMOTE PLASMA CLEANING
SOURCE HAVING REDUCED
REACTIVITY WITH A SUBSTRATE
PROCESSING CHAMBER

Confirmation No. 8435

Examiner: Rudy Zervigon

Technology Center/Art Unit: 1792

APPELLANTS' REPLY BRIEF UNDER
37 CFR §41.41

Mail Stop Appeal Brief
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Commissioner:

This Reply Brief is filed in response to the Examiner's Answer mailed October 25, 2010.

STATUS OF CLAIMS

Claims 22-24 and 27-28 are pending and appealed. Claims 1-21 and 25-26 were canceled.

GROUND OF REJECTION TO BE REVIEWED ON APPEAL

The grounds of rejection to be reviewed on appeal have not changed after the Examiner's Answer was entered. The grounds to be reviewed are:

1) Whether claims 22-24 and 27-28 are obvious under 35 U.S.C. § 103(a) over Shang et al. (U.S. Patent 5,788,778) in view of Markunas et al. (U.S. Patent 5,018,479).

ARGUMENT

Appellant's original Appeal Brief argued that contrary to what is stated in earlier Office Actions, Shang et al. does not teach "mixing said flow of said reactive radicals and said diluent gas flow at a mixing location downstream of a location of forming said flow of said reactive radicals and anterior to said chamber to form a gas-radical mixture" as recited in claim 22. See Appeal Brief, pages 4-5.

In reply, the Examiner's Answer has clarified that the Examiner believes this limitation of claim 1 is met by Shang et al. in the following manner. The flow of reactive radicals is generated in remote activation chamber 46 from gas sources 44, 52; the diluent gas flows from Shang's gas sources 32, 34 (as Shang is modified by Markunas)¹, and the reactive radicals and diluent gas meet and are mixed at the T-intersection identified in Fig. 1 by reference number 33. See Examiner's Answer, pages 3-8 and in particular, page 8, last paragraph (stating the Examiner's position that the diluent gas is gas source 32, 34).

¹ Shang specifically states gas sources 32 are deposition gases. See Shang, col. 4, lines 21-22 ("outside of chamber 10, there is a gas supply 32 containing the gases that are used during deposition"). Since claim 22 specifies that the claimed "diluent gas" is at least one of an inert or a reducing gas, the Examiner relies upon Markunas for its disclosure that deposition gases may include hydrogen which is a reducing gas.

For convenience, Figure 1 of Shang has been reproduced below and annotated to indicate the manner in which the Examiner is applying Shang towards the invention of claim 22.

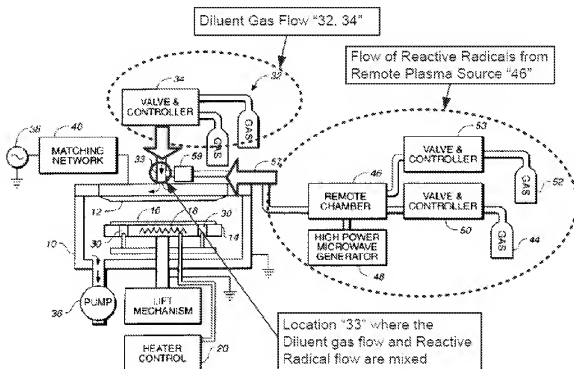


Fig. 1 of Shang (annotated in accordance with the Examiner's interpretation)

The problem with the Examiner's position is that gas control valve 34 and gas source 32 are used to introduce deposition gases into the chamber during a substrate deposition step (see e.g., Shang, col. 4, lines 21-27) while gas sources 44, 52 and remote chamber 46 are used to introduce etchant gases into the chamber during a chamber clean step (see e.g., Shang, col. 4, lines 32-37). A person of ordinary skill in the art will readily appreciate that deposition and chamber clean steps are mutually exclusive. That is, they do not occur at the same time. Deposition steps occur with the substrate in the substrate processing chamber so that the material being deposited is deposited on the substrate. Chamber clean steps occur after one or more deposition steps have taken place and after the substrate(s) has been transferred out of the chamber so as to not damage a substrate or the thin film layers deposited over a substrate.

Thus, there is absolutely no teaching in Shang (or by Shang as the Examiner has modified it with Markunas) that the diluent gas from source 32, 34 flows into location 33 at the same time as the reactive radicals from remote chamber 46, line 57 flow into location 33 during a chamber clean process. Thus, the combination of Shang and Markunas does not disclose "mixing said flow of said reactive radicals and said diluent gas flow" as part of a chamber clean process as required by claim 22.² Accordingly, Applicants respectfully assert that a prima facie case of obviousness has not been established and respectfully request that the rejection of claim 22, and its dependents, be withdrawn.

Appellants further note that the motivation set forth in the Examiner's Answer for combining the Markunas and Shang references, and the combination itself, is nonsensical. For example, the Examiner's Answer states that the grounds for the motivation of the combination are that:

"both Markunas and Shang teach plasma deposition processes, the control of gas phase chemistry would be considered a result effective variable lending to film quality control and reproduction." See page 13, second to last paragraph (emphasis added).

The Answer then goes on to state:

"It is further noted that Shang's application of plasma source gases (52, 54; Figure 1) is for cleaning as discussed above, and said cleaning process is done between deposition process utilizing Shang's deposition gases 32, Figure 1. Thus, a person of skill in the art at the time the invention was made would find Markunas's motivation *for adding hydrogen as an aid in deposition* as beneficial for "moderating the gas phase chemistry" as taught by Markunas (column 8, lines 45-50). Examiner's Answer, paragraph spanning pages 12-13 (emphasis added, different from emphasis in the original).

Appellants note that invention of claim 22 pertains to "a method of removing residue from a substrate processing chamber" (i.e., a chamber clean process) and fail to see how combining the Markunas and Shang references to moderate the gas phase chemistry of a deposition process can result in the claimed chamber cleaning process. Indeed, combining Markunas and Shang so that the hydrogen gas from Markunas' is added to the deposition gases

² To the extent that the Board recognizes that Shang teaches that gases from the first and second sources of gases may be combined (see Shang, col. 4, lines 37-39 "One may also combine the first and second gas supplies if the gases are such that mixing is desired."), Appellants note that Shang does not disclose any particular manner for such combination *****

of Shang to moderate the gas phase chemistry of a deposition process does not in any way result in the chamber cleaning process set forth in claim 22. Additionally, Appellants believe the Examiner is wrong in asserting that Shang teaches utilizing deposition gases 32 during its chamber clean process. The Shang cleaning process utilizes gas sources 44, 52. See e.g., Shang, col. 4, line 32 to col. 5, line 30. There is no disclosure or suggestion within Shang that the deposition gases 32 are used during a chamber clean step (they are, after all, deposition gases, not clean gases).

CONCLUSION

For any and all of the above reasons, Appellants respectfully submitted that the rejection of claims 22-24 and 27-28 should be reversed.

Respectfully submitted,

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CLAIMS APPENDIX

1.-21. (Canceled)

22. (Previously Presented) A method of removing residue from a substrate processing chamber, said method comprising the steps of:

forming a plasma remotely with respect to said chamber, said plasma including a plurality of reactive radicals;

forming a flow of said reactive radicals traversing toward said chamber;

forming a nonplasma diluent gas flow, wherein said nonplasma diluent gas flow comprises at least one of an inert gas or a reduction gas;

mixing said flow of said reactive radicals and said diluent gas flow at a mixing location downstream of a location of forming said flow of said reactive radicals and anterior to said chamber to form a gas-radical mixture; and

flowing said gas-radical mixture into said chamber to remove residue from within said chamber,

wherein each step of the method occurs without a wafer in said chamber.

23. (Previously Presented) The method as recited in claim 22 wherein said flow of reactive radicals and said gas flow are established to maintain a pressure within said chamber below one torr.

24. (Previously Presented) The method as recited in claim 22 wherein said reactive radicals comprise atoms associated with a reactive gas, with said reactive gas being selected from a group consisting of NF₃, dilute F₂, CF₄, C₂F₆, C₃F₈, SF₆, and ClF₃.

25.-26. (Canceled)

27. (Previously Presented) The method as recited in claim 22 wherein said chamber has components therein, with a subset of said radicals in said gas-radical mixture reacting with said components creating a residue and further including the step of exhausting

said residue, with a rate at which said residue is exhausted depending upon a rate of said diluent gas flow.

28. (Previously Presented) The method as recited in claim 22 wherein said diluent gas flow travels at a first rate and said flow of said reactive radicals travel at a second rate with a ratio of said first rate to said second rate being at least 2:1.